

Poland Petroleum Refinery Sludge Lagoon Demonstration Project

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POLAND PETROLEUM REFINERY SLUDGE LAGOON DEMONSTRATION PROJECT

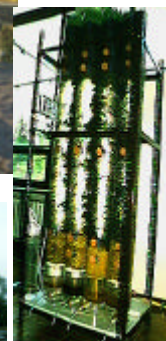
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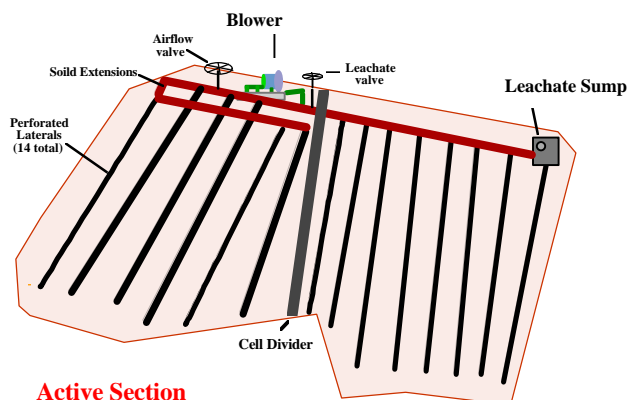
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ABSTRACT

The US Department of Energy and the Institute for Ecology of Industrial Areas have been working together to develop mutually beneficial, cost-effective environmental remediation technologies such as the demonstration of bioremediation techniques for the clean up of acidic petroleum sludge impacted soils at an oil refinery in southern Poland. After an expedited site characterization, treatability study, and a risk assessment study, a remediation strategy was devised. The waste material was composed primarily of high molecular weight paraffinic and polynuclear aromatic hydrocarbons. A biopile design which employed a combination of passive and active aeration in conjunction with nutrient and surfactant application was used to increase the biodegradation of the contaminants of concern.



BIOPILE DESIGN



Active Section

Passive Section



Site characterization and treatability studies, including soil column and microcosm experiments were conducted prior to selection and design of biopile technology.

SITE DESCRIPTION

Waste from 80 yrs of petroleum processing at the Czechowice Oil Refinery using sulfuric acid extraction process.

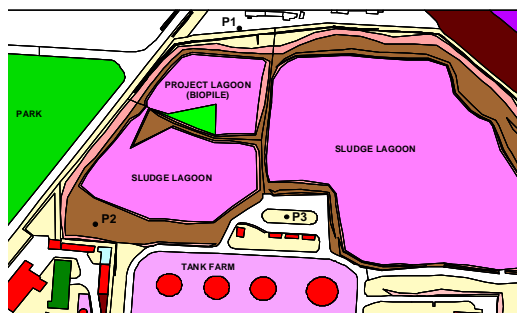
Approximately 120 thousand tons of weathered acidic petroleum sludges exist. Ten thousand tons added per year.

Sludge lagoons impacted a total of 3.8 hectares .

Benzo(a)pyrene and BTEX compounds were identified as the primary contributors to risk for present and future site workers.

Approximately 3,300 m³ of contaminated soil (mean TPH concentration of 30,000 ppm) was remediated.

Biopile constructed within the the smallest sludge lagoon (0.8 ha).



Proximity of sludge lagoons to a city park

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OPERATIONAL CAMPAIGNS (OC)

OC-1. Mobilization and air injection startup (9/25/97-1/27/98)

OC-2. Air injection (2/1/98-4/15/98)

OC-3. Air injection + fertilizer (4/16/98-6/30/98)

OC-4. Air injection + fertilizer + leachate recirculation (7/1/98-9/29/98)

OC-5. Air injection + fertilizer + leachate recirculation + surfactant (7/4/99-9/29/99)



Active aeration via air injection



Passive aeration via barometric pumping using BaroBalls™

RESULTS

Over the 20 month project, more than 81% (120 metric tons) of petroleum hydrocarbons were biodegraded. Despite the fact the material treated was highly weathered and very acidic, biodegradation rates of up to 121 mg/kg soil/day in the actively aerated side (82 mg/kg soil/day in the passive side) were achieved in this biopile. Microbial counts and dehydrogenase measurements support the biodegradation rates.

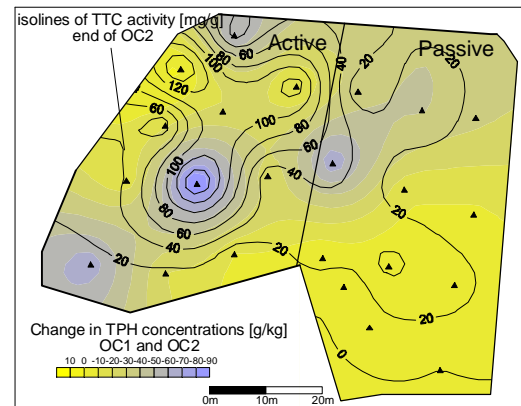
Biodegradation Rate by Operating Campaign and Treatment

Campaign	Average	Passive	Active
OC-1	80	44	119
OC-2	88	82	94
OC-3	<33	33	0
OC-4	<37	0	37
OC-5	91	60	121

All values in mg/kg soil/day

TPH Inventory by Operating Campaign

Baseline	OC1	OC2	OC3	OC4	OC5
(Tons) 148	100	68.6	68.6	66.8	28.1
% Remaining	68	46	46	45	19



CONCLUSIONS

- Measurement of dehydrogenase activity (TTC) provides real-time account of biodegradation process.
- Surfactant use can enhance contaminant bioavailability and nutrient utilization, thus increasing contaminant biodegradation.
- Passive aeration useful in areas where utilities are not available and/or when there are no time constraints.
- Passive aeration applicable to facilitated natural attenuation.
- Biopile technology is cost-effective.

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COSTS OF PROJECT

\$98/cubic meter treated



Site of former sludge lagoon

(A,B,C,D) MPN Petroleum Degraders: Active Deep, Passive Deep, Active Shallow, Passive Shallow

